

## SECTION 02510

### COOLING WATER AND FIRE PROTECTION

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. This Section includes water-distribution piping and specialties five feet outside the building perimeter for the following:
  - a. Water services.
  - b. Fire-service mains.
  - c. Cooling water return (CWR) and cooling water supply (CWS).
  - d. Aboveground water piping for applications other than water-service piping.
2. Work for each system includes design and location of each system, connections to existing work, required components, related earthwork, concrete work and necessary testing, to provide complete, functioning systems.
3. Work includes interface with aboveground systems within building limits 12 inches above finish floor or as shown, and provision of blind flange at interface.
4. Complete disinfection, testing, and flushing, separately from above ground systems.

###### B. Related Sections:

1. Underground Piping Systems - Division 15.
2. Cast-In-Place Concrete – Division 3.

##### 1.2 SYSTEM DESCRIPTION

###### A. Performance Requirements

1. Coordinate connection to fire water main, chilled water return and chilled water supply with Owner's Representative.

##### 1.3 SUBMITTALS

###### A. Product Data

1. Furnish submittals for items that are identified in this Section by different typeface and bracketed code (e.g., *Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified under this Article.
2. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on specific system shown.

- B. Shop Drawings.
  - a. Submit fire protection shop drawings as follows:
    - 1) Prepare and submit shop drawings to Underwriter and Registered Design Professional per requirements of Contract Documents.
    - 2) Products with Underwriters Laboratory (UL) Label or Listing in latest issue of UL "Fire Protection Equipment List" and Supplement current as of issue date of this Specification, products with FM Label or Listing in current "Factory Mutual Approval Guide" and approved products and are acceptable materials and equipment.
    - 3) Submit to Registered Design Professional only those shop drawings that have been Underwriter "approved" or "approved as noted".
- C. Quality Assurance/Control Submittals
  - 1. *Test reports [T]*: Submit test data of structural integrity, leakage and performance test.
  - 2. Manufacture's Instructions
    - a. Submit Per Division 1, General Requirements, operating and maintenance data, special tools, and spare parts list.
- D. Closeout Submittals:
  - 1. Submit as-built drawings and progress prints per Division 1, General Requirements.

#### 1.4 QUALITY ASSURANCE

- A. Qualifications
  - 1. Fire protection system work shall be supervised and performed by personnel regularly engaged in installation of fire protection systems per Underwriter's and NFPA Standards.
  - 2. Underground Cooling Water System work shall be supervised and performed by personnel regularly engaged in the installation of similar systems.
- B. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- C. Certifications
  - 1. Piping materials shall bear label, stamp, or other markings of specified testing agency.
  - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 3. Comply with ASTM F 645, "Standard Guide for Selection, Design, and Installation of Thermoplastic Water Pressure Piping Systems", for selection, design, and installation of thermoplastic water piping.
  - 4. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

5. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression. Provisions and recommendations of NFPA constitute mandatory minimum requirements for specified work.
6. Owner will make no payment for extra charges for work added in order to comply with NFPA Standards and Owner's Underwriter requirements.

D. Pipe Manufacturer Representation

1. The Contractor shall provide on-site a representation from the cooling water system piping manufacturer to oversee installation of cooling water system.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. Storage: Use precautions for valves according to following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

D. Deliver piping with end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending. Storage of plastic pipe shall be in accordance with manufacturers guidelines.

## 1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements shown:

1. Notify Owner not less than 2 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### A. General

1. Ells, tees, reducing tees, wyes, couplings, increasers, crosses, transitions and end caps shall be of same Type and Class of materials as pipe, or of equal or greater pressure rating and of equivalent chemical-resistant properties where different materials are proposed and permitted.

#### B. Type DIWP, Ductile Iron Water Pipe

1. Fire Protection
  - a. Ductile Iron Water Pipe: Underground Service. Centrifugally cast, per American National Standards Institute (ANSI)/American Water Works Association (AWWA) C151/A21.51 Class 52 minimum with push-on or mechanical joints per ANSI/AWWA C111/A21.11 with ductile iron fittings, 150 psig pressure rating per ANSI/AWWA C110/A21.10 or C153/A21.53, rubber gaskets with duct tips. CorTen A T-head bolts and nuts for mechanical joints.
2. Cooling water supply (CWS) and cooling water return (CWR).
  - a. Ductile Iron Water Pipe: Underground Service. Centrifugally cast, per ANSI/AWWA C151/A21.51 CLASS 52 minimum with restrained joints per ANSI/AWWA C111/A21.11 and with ductile iron fittings, 350 psig pressure rating per ANSI/AWWA C110/A21.10 and C153/A21.53.
3. Ductile Iron Grooved Joint Pipe: Above ground service. Ductile Iron Grooved Joint per ANSI/AWWA C-606. Use CLASS 250 minimum pipe for grooved joint.
4. Ductile Iron Flanged Pipe: Ductile iron flanged pipe per ANSI/AWWA C115/A21.15; and ductile iron fittings, 250-psig pressure rating, per ANSI/AWWA C110/A21.10.
  - a. Cement Lining: Cement line pipe and fittings to double the “standard thickness” and seal coat per ANSI/AWWA C104/A21.4.
5. Restrained joints: Use joints that allow deflection and field disassembly. Retainer glands with set screws in pipe surface are strictly prohibited.
  - a. American Ductile Iron Pipe Company, Birmingham, AL, “LOK-FAST”.
  - b. United States Pipe & Foundry Co., Birmingham, AL, “TR Flex”.
  - c. Ebaa Iron Sales, Inc., East Land, TX, “Megalug”.

### 2.2 COMPONENTS

#### A. Gate Valves

1. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves: AWWA C509, ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
  - a. Minimum Working Pressure: 250 psig (1725 kPa).
  - b. End Connections: Mechanical joint.
  - c. Interior Coating: Complying with AWWA C550.

## 2.3 ACCESSORIES

### A. Valve Boxes

1. Valve Boxes: Comply with AWWA M44. Cast iron, screw adjustable, 3-piece, with locking cover having appropriate legend, and 5-1/4-inch shaft. Fully extended length of box shall exceed length required by depth of cover by not less than 4 inches. Provide 1 valve operating wrench.
  - a. Tyler Pipe, Tyler, TX.
  - b. Opelika Foundry Co., Opelika, AL.

### B. Corporation Stop

1. Corporation Stop: Brass or bronze, ground and lapped key with AWWA C800 inlet threads. Outlet threads shall suit service pipe. Where piping is not being used for electrical grounding, stop shall be insulating type with 90-degree tube flare.
  - a. Mueller Co., Decatur, IL.

### C. Tapping Valve And Sleeve

1. Tapping Valve and Sleeve: Valve UL Listed or FM approved, Mechanical Joint Tapping Sleeve, Resilient Wedge Ball Valve, mechanical fit and flanged ends, flange for indicator post if required, tapping fitting and sleeve for line tapping. Provide valve and sleeve with working pressure rated same as pipe service and manufacturer-recommended gaskets, sleeves and glands to ensure complete, watertight connection.
  - a. Clow Valve Co., Oskaloosa, IA.
  - b. Mueller Co., Decatur, IL.

### D. UNDERGROUND STRUCTURES

1. Type GW, Frame And Cover For Valve Wells:
  - a. East Jordan Iron Works, East Jordan, MI, "No. 1040," Type "A" Solid Cover.
  - b. Neenah Foundry Co., Neenah, WI, "R-1642 Solid Lid".
2. MANHOLE STEPS:
  - a. Ductile iron, per United States Department of Labor Occupational Safety and Health Administration (OSHA) requirements.
    - 1) Neenah Foundry Co., Neenah, WI.
  - b. Stainless steel per local code and OSHA requirements.
  - c. Formed steel with plastic jacketed exposed surfaces per local code and OSHA requirements.
  - d. Fiberglass reinforced plastic per local code and OSHA requirements.
3. Precast Components: American Association of State and Highway Transportation Officials (AASHTO) H20/HS20 Loading (16,000 lb wheel loads)
  - a. Riser Sections. ASTM C 478, "Standard Specification for Precast Reinforced Concrete Manhole Sections", with factory formed openings.
  - b. Compression Elastomer Joints. ASTM C 443, "Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets".
  - c. Base. ASTM C 478, "Standard Specification for Precast Reinforced Concrete Manhole Sections".

- d. Flat Slab. ASTM C 478, "Standard Specification for Precast Reinforced Concrete Manhole Sections".
  - e. Grade Rings. ASTM C 478, "Standard Specification for Precast Reinforced Concrete Manhole Sections", reinforced concrete rings totaling thickness from 6 to 9 inches (150 to 229 mm) that coordinate with diameter of frame and cover.
- 4. Masonry:
  - a. Brick. Type MB per ASTM C 32, "Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)", Grade MS.
  - b. Block. Type CMU per ASTM C 139, "Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes", formed units to pit diameter with cones battered vertically and horizontally if circular.
- 5. Leveling Course:
  - a. 1:10 ratio cement/sand dry mixture.
- 6. Plaster Coating:
  - a. Cement plaster coating 1/2 inch thick.
- E. Cast Iron Fittings: Cast iron, 125 PSI UL Listed, galvanized, screwed, ASTM A 126, "Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings", Grade A, ANSI B16.4.
- F. Valves:
  - 1. Crane Bolingbrook.
  - 2. Stockham Valves, Paris, TX.
- G. Pipe Saddle (Cast/Ductile Iron Pipe). Cast iron tapped for 2-inch NPT, molded rubber gasket, 2 U-bolts.
  - 1. Mueller Co., Decatur, IL.
- H. Pipe Coupling (Steel Pipe). Extra heavy, tapered thread black carbon steel.

## 2.4 FINISHES

- A. Bituminous Coating:
  - 1. Carboline, Zenia, OH, "Bitumastic 50".
  - 2. International Paints Houston, TX, "Intertuf 100"
- B. Joint Packing:
  - 1. Tarred oakum or jute per Fed. Spec. A-A-1186, Type II.
- C. Sleeves: Standard weight carbon steel pipe with continuously welded collar plates, hot-dip galvanized after fabrication.
- D. Expansible Seal: Mechanically-expansible elastomer seal devices with stainless steel hardware.
  - 1. PSI Thunderline Corp., Houston, TX "Link Seal".
  - 2. Calpico, Inc., San Francisco, CA, "Sealing Linx"

- E. Rods and Clamps:
  - 1. Rods and clamps for thrust restraint shall be hot-dipped galvanized carbon steel with non-embedded portions coated per NFPA requirements with BITUMINOUS COATING.
- F. Gasket Joint Lubricant:
  - 1. Use either pipe manufacturer's recommended gasket lubricant or hydrated bentonite gel applied per manufacturer's instructions as joint lubricant.
    - a. Colloid Environmental Technologies Company, Arlington Heights, IL, "Volclay".
- G. Epoxy Bonding Compound: 2-component system suitable for bonding wet or dry concrete to each other and to other materials.
  - 1. Euclid Chemical Co., Cleveland, OH, "Epoxy NO. 452".
  - 2. Tamms, Kirkland, IL, "Duralbond"
  - 3. Sika Corp., Lyndhurst, NJ, "Sikadur 32 Hi-Mod".
- H. Embedment (Bedding and Initial Backfill). Refer to Section 02057 for definitions of soils and aggregates, their uses and installation methods.
- I. Concrete. Compressive strength of 3000 psi per ACI 301 and ASTM C 94, "Standard Specification for Ready-Mixed Concrete".
- J. Thermal-Joining Filler Metal:
  - 1. Solder (hard). Tin-antimony "95-5 hard solder"; ASTM B 32, "Standard Specification for Solder Metal".
  - 2. Brazing Alloy. Silver solder per American Welding Society (AWS) A5.8-77 Classification BCu P-5. Use of brazing alloy containing cadmium is prohibited.
- K. Epoxy Grout (Premixed, Nonshrink Type):
  - 1. Great Lakes Industrial Supply, Dearborn Heights, MI, "Unisorb V100"
  - 2. Master Builders Technologies, Cleveland, OH, "Ceilcote 648 Series".
  - 3. Tamms, Kirkland, IL, "Polygrout"
- L. Marking Tape: Service identified 3 inch wide, blue color foil-backed polyethylene tape, or non-foil tape. Fire water service.
  - 1. Reef Industries, Inc., Houston, Texas, "Terra Tape".
  - 2. Seton Identification Products, Branford, CT.
  - 3. Thor Enterprises, Sun Prairie, Wisconsin.
- M. Chlorine Solution for Disinfection Work. Chlorine solution of not less than 50 parts per million (PPM) of chlorine obtained from chlorine gas, calcium hypochlorite or commercial laundry bleach with minimum 5.25 percent available chlorine.
  - 1. Calcium Hypochlorite:
    - a. Olin Chemicals Groups, Norwalk, CT, "HTH".
    - b. Ashland Chemical Inc., Columbus, OH.
    - c. Mutchler Chemical Co., Inc., Westwood, NJ.

2. Material Required For 1000 Gallons Of Solution

SOLUTION STRENGTH	50 PPM	100 PPM
CALCIUM HYPOCHLORITE (LBS)	0.6	1.2
LAUNDRY BLEACH (GALLONS)	1.0	2.0

PART 3 EXECUTION

3.1 GENERAL

- A. The following construction methods are not intended to be completely detailed. Provide properly functioning systems per applicable codes, manufacturer's instructions and standards and best accepted safe practice of Trade.

3.2 EXISTING UTILITIES AND SERVICES

- A. General
1. Refer to Earthwork – Division 2.
- B. New Connections
1. Make complete connections to new or existing structures. Repair damage caused as result of Work. Repair work to comply with Contract Documents at no increase in Contract sum.

3.3 PIPING EARTHWORK

- A. Excavation And Backfill
1. Perform excavating and backfilling required for Work, per procedures specified in Soils and Aggregates Division 2, and Earthwork - Division 2 and the following requirements.
  2. Trim to lines and elevations in manner specified under Embedment. Embedment starts at final trimmed trench elevation and ends at 12 inches above top of pipe or component; "Backfill" starts 12 inches above pipe or component. Use manual methods in areas adjacent to buried construction and utilities to avoid damage or unscheduled service interruption. Limit trench width or embankment conditions to preclude excessive earth loads on installed piping system.
- B. Embedment (Bedding And Initial Backfill)
1. Trim rough trench to subgrade and provide embedment as defined in Soils and Aggregates-Division 2 and as shown. Provide stable, uniform support consisting of minimum compacted thickness below bottom of exterior surface of pipe, including bell, as shown but in no case less than 4 inches. Shape bedding to provide full length barrel support and to prevent point loading at pipe joints. Place and compact per Division 2, Soils and Aggregates.
  2. When bottom of excavation cannot support pipe, excavate to further depth and width and refill to pipe laying grade with bedding material per Division 2, Soils and Aggregates.



### 3.4 PIPING INSTALLATION

#### A. General

1. Install per NFPA 24 and ANSI/AWWA C600.
2. Before lowering pipe into trench, clean, and visually inspect for apparent defects. Remove defective pipe from site promptly. Before and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in directions for pipe passing under or through building grade beams.
3. Where pipe is embedded in an underground concrete structure, provide joint within 18 inches of exterior surface of structure, capable of absorbing deflection without leakage.
4. Clean and lubricate elastomer joints before assembly.
5. Coat ferrous joints including bolts, nuts, flanges, and like with Bituminous Coating.
6. During progress of construction, protect open ends of 18 inch and smaller pipe, fittings, and valves to prevent admission of foreign matter. Place plugs or flanges in ends of installed work whenever work stops. Plugs shall be commercially manufactured products.
7. Interface with aboveground systems within building limits as shown or specified. Provide accessories for flushing, disinfecting and testing. Provide blind flange at interface.

#### B. Joint Construction

1. Make pipe joints according to the following:
  - a. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  - b. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
  - c. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with keyed couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
  - d. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Utility Materials – Division 2 for joining piping of dissimilar metals.

#### C. Changes In Alignment

1. Make horizontal or vertical changes in alignment using standard fittings intended for angular changes. Incremental changes less than or between standard fittings may be made by deflecting pipe joints with deflection not more than 1/2 maximum deflection recommended by manufacturer.

#### D. Restraint

1. Provide restraint or anchorage for pipe and fittings as shown, or where required to restrain each system under test pressure and normal operating pressure. Where provisions are not shown, provide restraint per NFPA 24.
2. Provide rods and clamps as shown. Also provide rods and clamps elsewhere for additional anchorage and construction conditions to supplement, but not to be substituted for, anchorage shown.

3. Where rods and clamps or restrained joints are used, restrain each leg the following minimum length, or to next restrained leg:

Nominal Pipe Diameter (Inches)	Length of Restrained Leg (Feet)
3	40
4	50
6	60
8	80
10	100
12	120
Over 12	See Profiles (CE-06)

4. Paint joints (bolts, nuts, flanges and fittings) and rods with heavy bituminous coating. See Section 96 of NFPA No. 24. Use of mechanical joints utilizing retainer gland with set screws in pipe surface is prohibited.
5. Provide thrust blocks where necessary to absorb hydraulic thrust at caps, plugs and at system change of direction fittings. Furnish 2500-psi minimum strength concrete placed against undisturbed soil with an area sufficient to provide load transmittal without movement.

E. Type DIWP, Ductile Iron Water Pipe

1. Install per AWWA C600 and AWWA M41.
2. Provide necessary special fittings and clamps for anchorage, socket clamping, rods, piers, bases, anchors and thrust blocking, off-sets, tees, crosses, dead-ends, and connection transitions.
3. Install polyethylene encasement per ANSI/AWWA C105/A21.5
4. Install ball joint per manufacturer's instructions. After testing, coat ball joint with Bituminous Coating, and wrap with plain mineral wool blanket held in place with approved tape or wire.

F. Epoxy Bonding To Existing Materials

1. Use Epoxy Bonding Compound to set sleeves or pipes in existing concrete or to bond dissimilar materials.
2. When applied per manufacturer's instructions, compounds shall be capable of initial curing within 48 hours at temperatures as low as 40 degF and shall be capable of bonding any combination of the following properly prepared materials. Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron, and carbon steel.

G. VALVE INSTALLATION

H. Valve And Box

1. Provide valve and box as shown. Coat underground portions of valve and box with Bituminous Coating before installation. Coat uncoated or marred surfaces including bolts before backfilling. Install valve and box.

I. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

- J. UL/FM Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- K. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- L. Relief Valves: Install aboveground with shutoff valve on inlet.
- M. Surface Penetrations
  - 1. Provide where piping passes through floors and concrete or masonry walls.
  - 2. Where penetrations are placed in existing concrete or masonry, utilize core drills diameter and secure sleeves watertight with Epoxy Bonding Compound. Do not load sleeves without approval of Registered Design Professional.
  - 3. Provide "Expansible Seal Device" as shown.
  - 4. Pack annular space full depth with mastic filler to provide liquid tight seal.
- N. Underground Structures
  - 1. Gate Wells
    - a. Provide as shown and per requirements of Cast-in-Place Concrete – Division 3.
  - 2. Air Release Assembly
    - a. Provide, where shown, an air release assembly consisting of pit, pit cover, piping, pipe saddle, isolating valve and air release valve. Bituminous coat pipe saddle after installation.

### 3.5 FIELD QUALITY CONTROL

- A. General
  - 1. Test equipment per manufacturer's published instructions, NFPA and as specified for system.
- B. Piping Systems Testing
  - 1. Test piping systems per NFPA 24, applicable governing codes, including State, local or insurance codes, and requirements of Owner's insuring agency.
  - 2. Provide necessary equipment and materials and make necessary test connections required to properly execute tests. Tests shall be witnessed by Registered Design Professional and authorized inspectors (or representatives) having jurisdiction, who shall be timely notified by Contractor to insure their being present during testing.
  - 3. Perform tests before piping is painted or concealed. Do not apply hydrostatic tests to piping with concrete thrust blocking which has not cured for more than 7 days. Hydrostatic test pressure forces shall not exceed design rating of thrust blocking. Backfill underground piping to degree necessary to preclude movement.
  - 4. Immediately correct defects discovered during tests and retest systems to complete satisfaction of Registered Design Professional and inspectors (or representatives) authorized to approve piping installation. Correct any piping system, or any portion thereof, which does not conform to best current installation practices of trade. Required corrections shall be at no additional cost to Owner.

C. Flushing Work

1. Contractor does testing with Owners insurer, Owners representative, or Registered Design Professional present to verify flushing and testing.
2. Before hydrostatic testing of new underground piping, devices and lead-ins shall be flushed at maximum flow rate that can be achieved. Flushing shall begin at closest point to water supply connection. Flush rate shall be recorded and maintained as part of Contractor's documentation and certification process. Flushing shall take place on following items in the following manner:
  - a. Devices: Each device shall be flushed by attaching not less than two 2 ½-inch hoses to the device. Each device shall be flowed at maximum rate available and long enough to insure clean, clear water has been obtained from each device. Appropriate reading shall be taken before closing and moving to next device.
  - b. Lead-in: Each lead-in shall be flushed by attaching not less than two 2 ½-inch hoses to lead-in. Each lead-in shall be flowed at maximum rate available and long enough to insure clean, clear water has been obtained from each lead-in.
  - c. Loop: Loop shall be flushed after devices and lead-ins have been flushed. Loop shall flow at working pressure long enough to insure clean, clear water has flowed from point of supply to outlet being flowed.
3. Provide temporary and permanent piping, equipment and materials required for flushing work. Coordinate cleaning of connections to existing systems with Registered Design Professional.
4. If equipment and piping systems are not properly cleaned and flushed, pay for resultant damage, necessary cleaning and flushing of systems to which connection was made and subsequent inspection, at no increase in Contract Sum.
5. Flush and drain dead ends.
6. Dispose of flushing water per governing codes and regulations.

D. Flow Test

1. Each lead-in shall have flow test performed.
2. Furnish equipment to verify flow rate of:

Pipe Size	Flow Rate
4-inch	390 GPM
6-inch	880 GPM
8-inch	1560 GPM
10-inch	2440 GPM
12-inch	3520 GPM

3. Do flow tests, record pitot readings and furnish readings to Approval Authority.

E. Hydrostatic Test

1. Underground pipe, devices and lead-ins shall be hydrostatically tested using following procedure:
  - a. Meet with Approval Authority before test to review areas to be tested and procedure that shall be followed.
  - b. Provide calculated allowable leakage documentation based on number of joints and hydrants being tested before hydrostatic test of underground system.

- c. Gauges shall be in place on pump up device and at most remote devices as minimal requirements.
- d. Piping and devices shall be pressurized to either 200 psi, or 50 psi above standard working pressure, whichever is greater.
- e. When piping and devices have been brought to appropriate pressure, pumping devices shall be disconnected from underground, gauges marked as to pressure achieved and record time it was achieved.
- f. Course of underground shall be walked to ensure that valves and devices are in appropriate position (open/closed), as previously reviewed with Contractor.
- g. Physically verify that valves are in appropriate and designated position during this walk through.
- h. Underground systems shall remain pressurized for 2 hours.

F. Verification of Volume Loss

- 1. Provide calculated allowable leakage documentation based on number of joints and hydrants being tested before hydrostatic test of underground system.
- 2. When hydrostatic test has been completed, pressure pump shall be reconnected and measured water volume shall be pumped back into system to bring system pressure back to its initial pressure. (This is based upon pressure loss during 2-hour test period).
- 3. Measured quantity pumped back into systems shall not exceed calculated allowable leakage per NFPA 24. If actual quantity exceeds allowable leakage, test is not acceptable.
- 4. Relieve the pressure on system and verify that gauges return to zero.
- 5. Test calculations and appropriate certificates are to be filled out, completed, and forwarded to appropriate parties.
- 6. Full flow volume tests are required upon completion of hydrostatic test of underground loops. Total volume flow required is found in Chapter 9 of NFPA 24.

G. Disinfection Work

- 1. General
  - a. Under direction of Registered Design Professional, disinfect potable water systems, fire protection systems and extension from existing systems connections, with an approved chlorine solution as specified, before system acceptance in accordance with applicable codes. Apply chlorinated solution at point of line origin nearest to existing chlorinated supply.
- 2. Procedures
  - a. Line being disinfected shall stand for minimum of 24 hours. Disinfecting solution shall produce no less than 10 parts per million chlorine residual at extreme end of line at end of retention period. After 24 hours flush out disinfecting solution until combined available chlorine residual is less than 1 parts per million. Maintain flushing velocity at 6 feet per second, unless higher velocities were achieved in previous flushing and unless otherwise approved.
  - b. Bacteriological count shall be made by Department of Public Health; if count is within United States Public Health Service recommendations and local code requirements, system may be put into service. Repeat disinfection process until specified results are obtained.

- c. Thoroughly disinfect pipe, valves, cocks, fittings, hoses, containers and miscellaneous items used for connection of new piping to an existing facility, immediately before installation. Clean and disinfect materials involved with solution containing not less than 2000 parts per million available chlorine and flushed with potable, i.e., disinfected water. A 2000 parts per million chlorine solution may be obtained by mixing 1 gallon of commercial laundry bleach per 25 gallons of water. Preclude contamination of disinfected materials before installation.
- 3. *TEST REPORTS [T]*
  - a. Submit copies of bacteriological tests including acceptance by authorities having jurisdiction.

#### H. General Piping Systems Testing Requirements

- 1. Before acceptance of Work, test piping systems in presence of Registered Design Professional and authorities having jurisdiction per respective and applicable governing codes and requirements of this Section. Backfill to extent required to prevent movement.
- 2. Provide necessary equipment and materials and make necessary test connections required to properly execute tests.
- 3. Use only potable water for hydrostatic testing.
- 4. Obtain water from point(s) designated by Registered Design Professional. Promptly remove temporary connections upon completion of testing or when directed by Registered Design Professional.
- 5. Prepare and maintain records of piping systems tests. Record Registered Design Professional and Contractor personnel responsibilities, dates, test gage identification numbers, ambient temperature, pressure ranges, rates of pressure drop and leakage rates.
- 6. Connection between new underground piping and existing shall be separately tested. Operating pressure shall be maintained on joint for not less than 30 minutes without leakage.
- 7. Bleed off air from hydrants and systems high points.
- 8. If testing shows leakage rates greater than specified limits, determine source(s) of leakage, repair or replace defective materials or and workmanship with new materials or workmanship. Retest installation until testing shows compliance with specified requirements.

#### I. Cooling Water (CWR and CWS)

- 1. Test per AWWA C600 except that minimum test pressure shall be 150 psig.

#### J. Fire Protection Water (FW) Testing

- 1. Test per NFPA 24.

#### K. IDENTIFICATION

- 1. Install continuous underground detectable warning tape during trench backfilling for underground non-metallic water-service piping. Locate tape below finished grade, directly over piping. See Section 2.14.L for underground warning tapes.
- 2. Permanently attach equipment nameplate or marker, indicating plastic water-service piping, on main electrical meter panel.

L. CLEANING AND FINISHING

1. Upon completion of work in each respective area, clean and protect work. Just before final acceptance, perform additional cleaning to provide clean equipment and areas to Owner.

END OF SECTION

Revision History	
Date	Rev. No.
A	0
B	0
C	0
D	0
E	0
F	0
02-19-09	0

SSK/djo

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